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PREFORMABLE MAT

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(57) Claim

1. A process for producing a preformable fiber mat having a top surface and a bottom surface comprising the steps of:

generating continuous glass fiber material from a glass forming bushing;

applying forming size to such glass fiber material;

chopping such glass fiber material into at least two distinct and varied lengths;

forming such chopped glass fiber into a mat;

applying a thermoplastic binder to such mat;

heating such mat such that the thermoplastic binder material softens and flows around such glass fiber material; and,

cooling such mat to solidify such thermoplastic binder material.

4. The process of claim 1, wherein such thermoplastic binder material comprises styrene soluble thermoplastic powered polyester resin and powdered polystyrene, mixed in equal amounts.

6. The process of claim 5, wherein such emulsion comprises a Hoechst polyvinyl acetate mowlith D-50 plasticized with 3% polyethylene glycol ester adipate.

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COMPLETE SPECIFICATION

(ORIGINAL)

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Complete specification for the invention entitled
"Preformable mat".

The following statement is a full description of this invention, including the best method of performing it known to me:-

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D E S C R I P T I O N

PREFORMABLE MAT

Technical Field

This invention relates to an improved fibrous mat and the method for producing the mat. The improved fibrous mat is intended for use as a preformable mat to be applied to the molding of complex fiber-reinforced shapes by the structural resin injection molding (RIM) process.

Background Art

Preformable mats are generally produced either from continuous strand fiber or chopped fiber placed on a heated matched die mold having the final desired shape. The fiber is generally held together by a thermosetting or thermoplastic polyester resin material and during the preform molding, a matrix resin is added to facilitate shape retention such as disclosed in United States Patent Nos. 3,936,558 and 3,969,171. Some processes provide for a nonwoven reinforcement structure which is composed of chopped fiber united into a coherent body without the use of binders or adhesives as disclosed in United States Patent Nos. 3,718,954 and 3,614,976.

The use of fiber mats to produce fiber reinforced preforms of useful shapes for molding to a final product is well-known. Fiber-reinforced articles are being created in new and varied applications requiring that the fiber-reinforcement material be contoured into complex curves and shapes. As the fiber mat goes through the

preform process it is stretched and bent to conform to the shape of the mold. The mat must have sufficient bulk or thickness to conform to the contours of the preform without tearing or thinning undesirably. Also, the mat must retain sufficient bulk to ensure proper resin flow through the preform during the RIM process. If the fibers are too thinly dispersed or compacted too tightly, the proper resin/fiber concentration will not be adequately achieved throughout the product.

Another preform manufacturing process eliminates the use of fiber mats such as those produced in United States Patent Nos. 3,936,538; 3,969,171; 3,614,936 and 3,718,954. This process generally utilizes additional machinery to apply fiber rovings directly to a preform. The present invention eliminates the need for this additional machinery and provides an improved mat for use in the preform process.

It is an object of this invention to produce a versatile preformable mat designed to make highly complex contoured preforms for subsequent molding by the RIM process.

Another object of this invention is to produce a preform mat of sufficient bulk to provide proper mat formation and fiber distribution after preforming

Yet another object of the present invention is to produce a preform mat which contains a proper combination of bulk and porosity to allow the evenflow of resin through the preformed mat during an RIM process.

Disclosure of Invention

The present invention achieves its objectives by applying fiber strands of two distinct lengths into a dry mat. The two lengths of fiber ensure that the mat will be formed with sufficient bulk or thickness to provide adequate fiber distribution during the preforming process. After the fibers are dry laid, a triple ingredient binder system is applied and the mat is heated to set the binder. The finished mat is of sufficient tensile strength to be wound on a roll to produce a shippable product.

Best Mode of Carrying Out Invention

The present invention provides an improved preform mat and the method of manufacturing the mat. The preform mat is advantageous for use with highly complex, contoured preforms as used with structural RIM reinforcements.

The preform mat of the present invention is prepared using glass fiber filaments of about 13 microns in diameter. Continuous filaments are received from a double bushing which generally yields 2986 meters (1,240 yards) of filament per kilogram (pound) of glass. As the fibers are formed, a forming size is applied. A preferred composition of the forming size is listed in Table I. After the forming size is applied, the filaments are split and grouped together in twelve distinct bundles.

TABLE I

Material	% by Weight As Received	Kilograms Per 378 liter	Lbs. Per 100 Gal.
OCF Epoxy Emulsion 732	8.78	33.26	73.25
Glacial Acetic Acid	0.03	0.10	0.23
Gamma-Methacryloxypropyl-trimethoxysilane	0.12	0.44	0.96
Chromium Nitrate 50% solution	0.36	1.36	3.00
Ammonium Chloride	0.04	0.14	0.30
Water (Demineralized)	90.67	343.34	756.26
	100.00	378.64	834.00

The bundled glass fibers are chopped, preferably, into 10.16cm (four inch) and 15.24cm (six inch) lengths and dry collected into a mat. The variation in fiber length is a major improvement upon previous chopped strand mat manufacturing wherein the glass fiber was chopped to one length, usually about 2.54cm (one) to 5.08cm (two inches), prior to collection into a mat. The varied fiber length and longer fiber length of the present invention provides a mat having the desirable bulk or thickness characteristics required in complex preforming operations. The 10.16cm (four inch) and 15.24cm (six inch) chopped fibers are laid into the mat on a 40/60 proportion on a weight basis.

The mat is bonded after its formation. Preferably, a triple ingredient binder system is used which is composed of a two powder mixture sifted onto the mat and an emulsion spray applied to the top and bottom of the mat. The powdered mixture and emulsion are applied to the mat in a 55/45 percent by weight mixture.

The powdered binder of preference is a mixture of equal amounts of a styrene soluble thermoplastic powdered polyester resin, having the properties listed in Table II, and polystryrene. The powder mixture is applied to the mat via traditional vibrators and dusters.

TABLE II

Properties	Minimum	Maximum	OCF Test Method
Softening point, ØC	108	114	S-04-3
Color, Gardner, 1:1 DMF	-	7	C-11-4
Zinc Stearate, %	0.7	1.5	Z-01-1
Particle Size Distribution, %			P-01-13
30 Mesh	-	0.0	
35 Mesh	-	0.1	
80 Mesh	58.0	78.5	
200 Mesh	12.5	32.5	
Through 200 Mesh	-	10.5	

The emulsion of preference is a Hoechst polyvinyl acetate mowlith D-50 plasticized with three percent (3%) of polyethylene glycol ester adipate, having the properties listed in Table III. The emulsion is sprayed onto the top and bottom of the mat by traditional spray equipment.

TABLE III

Properties	Minimum	Maximum
Solid %	48	52
Brookfield Viscosity c.p.s.	12000	28000
Plastificant %	0	0
Acidity Index (mg KOH/g)	1	4
Size of Particles, micron	0.8	1.2
P.H. 1:9	3	4
% Insoluble in Acetone	-	50

The mat is not compacted to achieve the desired bulk. It is nominally 4.8mm +/- 8mm thick.

After application of the powder/liquid binder mixture, the mat is processed through an oven where it is cured at about 250ØC to set the binder. The cured mat may have its edges trimmed, be inspected, and then rolled or packaged at a suitable processing station if immediate use of the mat is not required.

The preceding description of the preferred embodiment is intended to illustrate a preferred process by which the preform mat of the present invention is manufactured. The description of binder compositions and quantities and process is not, however, intended to be limiting upon the scope and content of the following claims.

Industrial Applicability

The invention will be found to be useful in making glass fiber preform mats for structural resin injection molding (RIM) processes.

The claims defining the invention are as follows:

1. A process for producing a preformable fiber mat having a top surface and a bottom surface comprising the steps of:

generating continuous glass fiber material from a glass forming bushing;

applying forming size to such glass fiber material;

chopping such glass fiber material into at least two distinct and varied lengths;

forming such chopped glass fiber into a mat;

applying a thermoplastic binder to such mat;

heating such mat such that the thermoplastic binder material softens and flows around such glass fiber material; and,

cooling such mat to solidify such thermoplastic binder material.

2. The process of claim 1, wherein such glass fiber material is chopped into 10.16cm (four inch) lengths and 15.24cm (six inch) lengths.

3. The process of claim 2, wherein such mat is composed of about 40% 10.16cm (four inch) chopped fiber and about 60% 15.24cm (six inch) chopped fiber by weight.

4. The process of claim 1, wherein such thermoplastic binder material comprises styrene soluble thermoplastic powered polyester resin and powdered polystyrene, mixed in equal amounts.

5. The process of claim 4, wherein such binder material further includes an emulsion, whereby such binder

material is applied to such mat in a mixture of about 55% powder and 45% emulsion by weight.

6. The process of claim 5, wherein such emulsion comprises a Hoechst polyvinyl acetate mowlith D-50 plasticized with 3% polyethylene glycol ester adipate.

7. The process of claim 5, wherein such powdered binder material is sifted into such mat and such emulsion is applied to the top surface and bottom surface of such mat.

8. The process of claim 1, wherein such mat is heated to a temperature of about 250ØC.

9. A process as described herein.

DATED this 15th day of June, 1989

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By Its Patent Attorneys,

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